LA-UR-21-27865
Approved for public release; distribution is unlimited.

Title:	Detecting Electrical Anomalies via Overlapping Measurements
Author(s):	Sontowski, Sina
Intended for:	ISTI Final Presentation, 2021-08-05 (Los Alamos, New Mexico, United States)
Issued:	2021-08-05

Los Alamos
NATIONAL LABORATORY

Detecting Electrical Anomalies via Overlapping Measurements

Sina Sontowski
Mentors: Nigel Lawrence, Deepjyoti Deka

August 1st, 2021


Electricity in
daily life

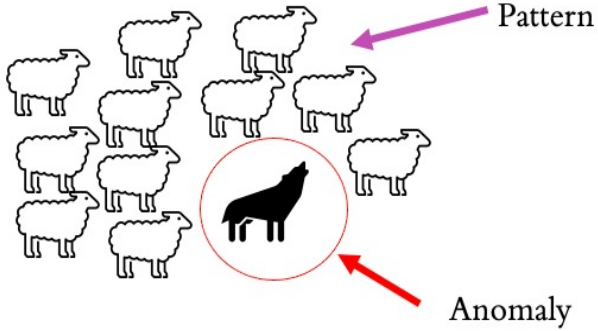
A street in Ukraine during a blackout after an attack on the power grid

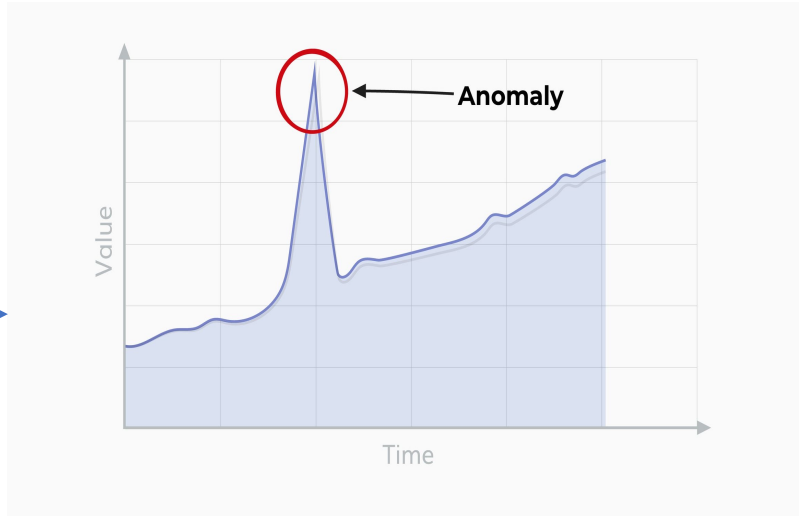
Overview

Background
Time Series
Anomaly
Detection

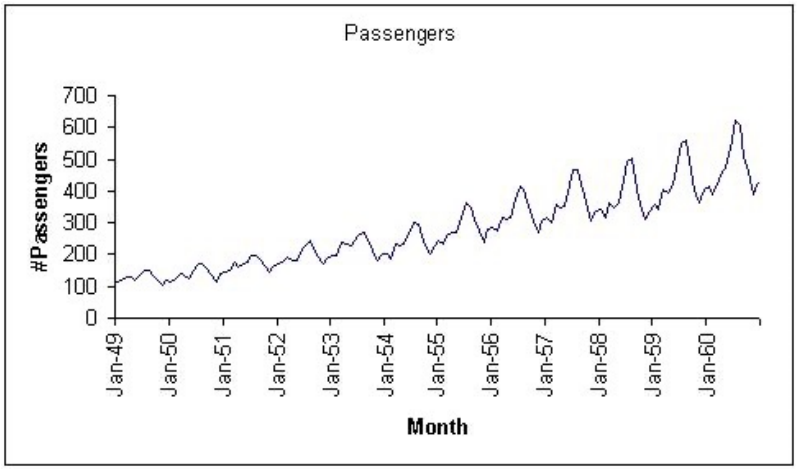
Overview of my
Research and
Importance

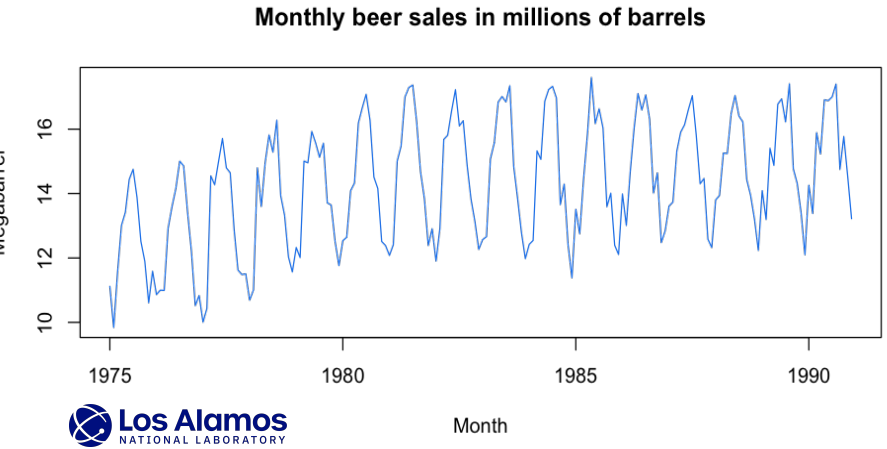
Results and
Conclusion

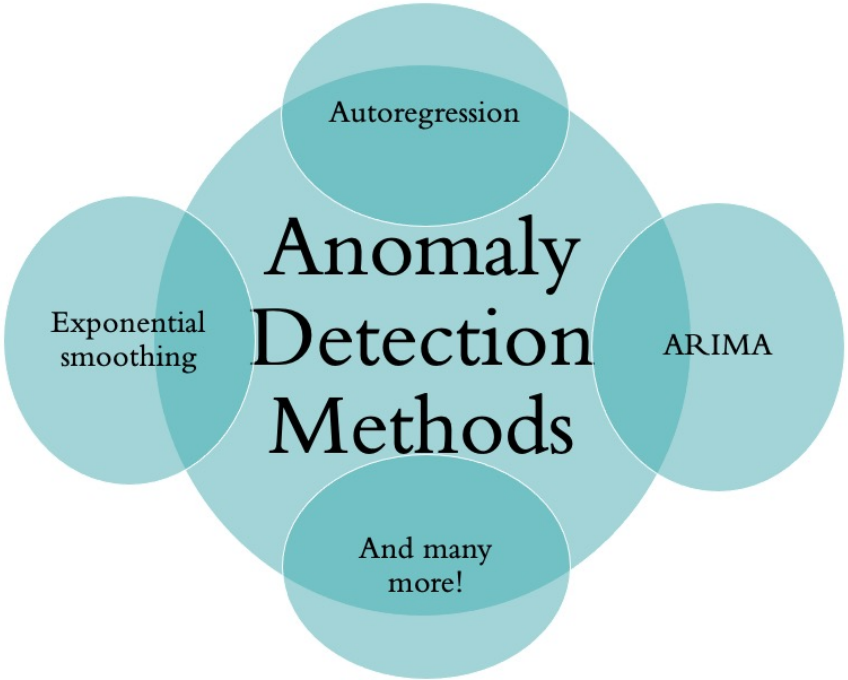




Globeafrique.com, vectorstock.com







Rstudio-pubs.org, Statista.com

My research

Start

Multiple independent systems with electrical measurements

Method

Anomaly Detection

Goal

Improve speed/accuracy

and validate measurements

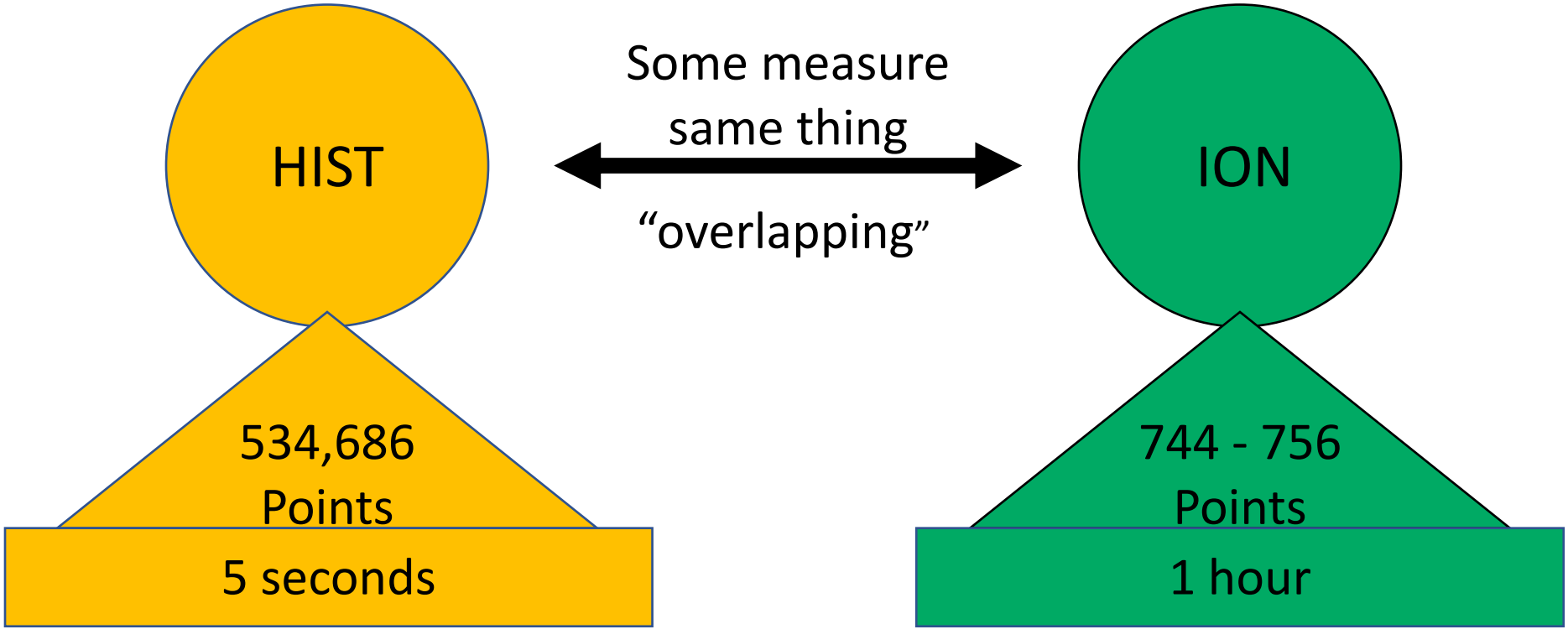
Main Contributions

Dealing with overlapping electrical measurements and validate them

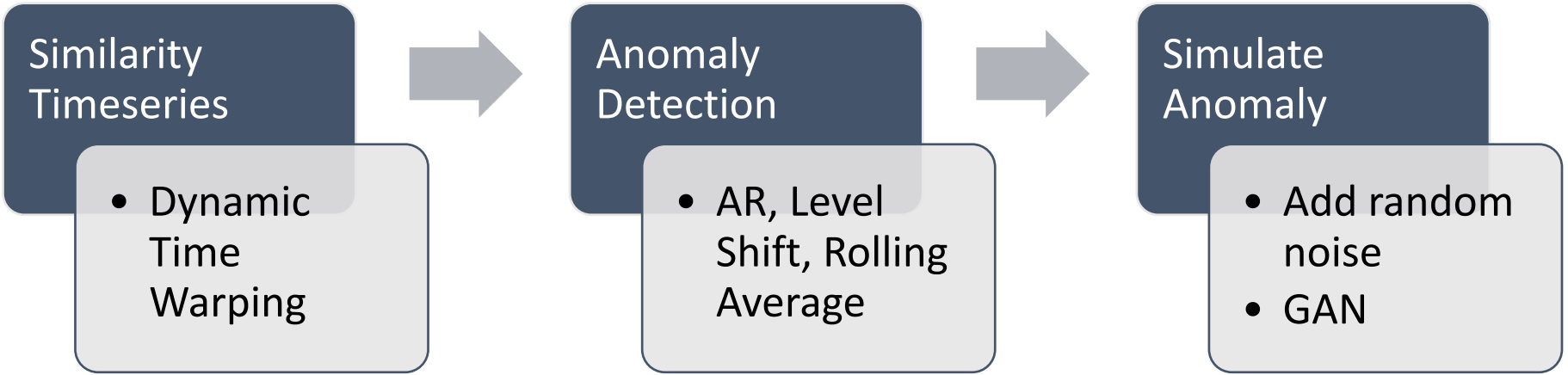
Compare results of anomaly detection algorithms

Improve accuracy/speed of anomaly detection (work in progress)

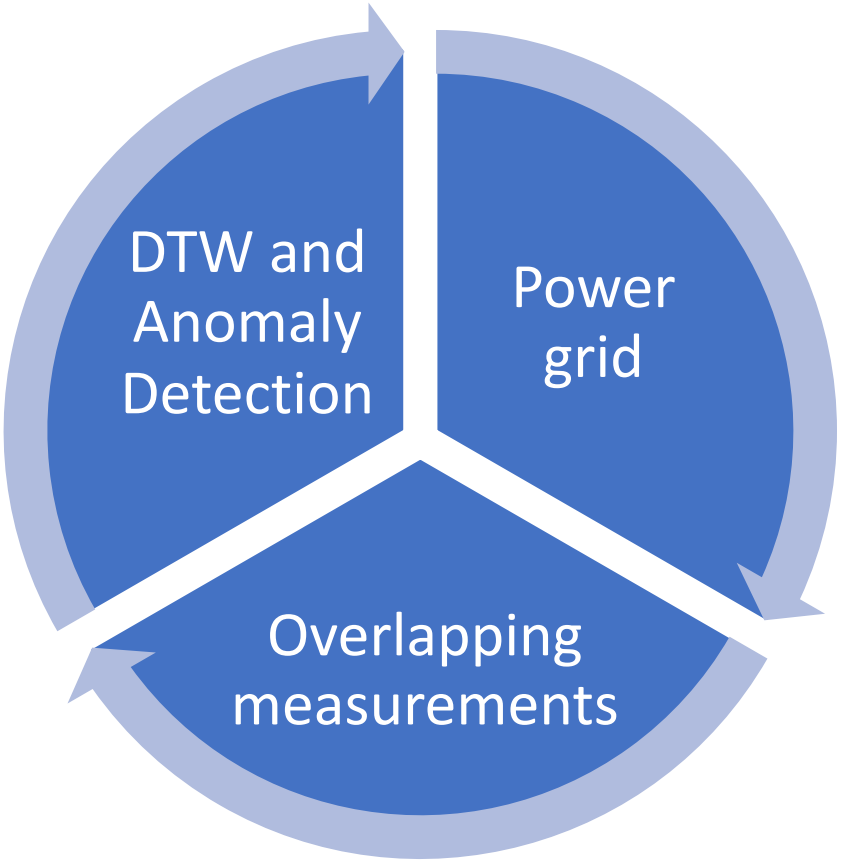
About the electrical measurements



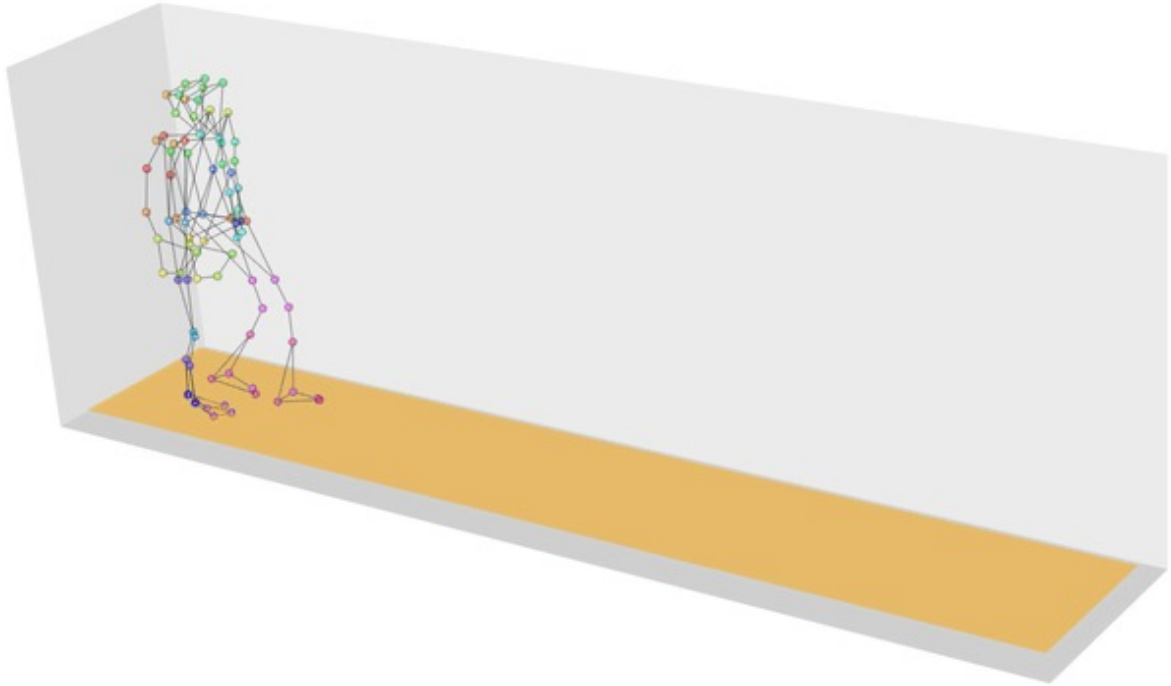
Our Approach



Why our Research is Unique



Dynamic Time Warping (DTW)



Wikipedia.org

Representative Sample

Step Size	• Taking every second point
Certain Point Amount	• First 200 Points
Date Range	• Three days

Run-time of Step size runs

Run Number	HIST steps	ION steps	Run-time (s)
1	100	2	2318.6
2	1000	1	616.7
3	1000	2	342.8
4	2000	2	222.6
5	3000	4	108.6
6	5000	7	65.7

Table 1: Step Size Running Times.

Run-time of Point Amount and Date Range

Run Number	Point Amount	Run-time (s)
7	100	24.3
8	200	38.6

Table 2: Point Amount Running Times.

Run Number	Date Range	HIST steps	ION steps	Run-time (s)
9	3 days	50	1	191.8

Table 3: Date Range Running Times.

Anomaly Detection

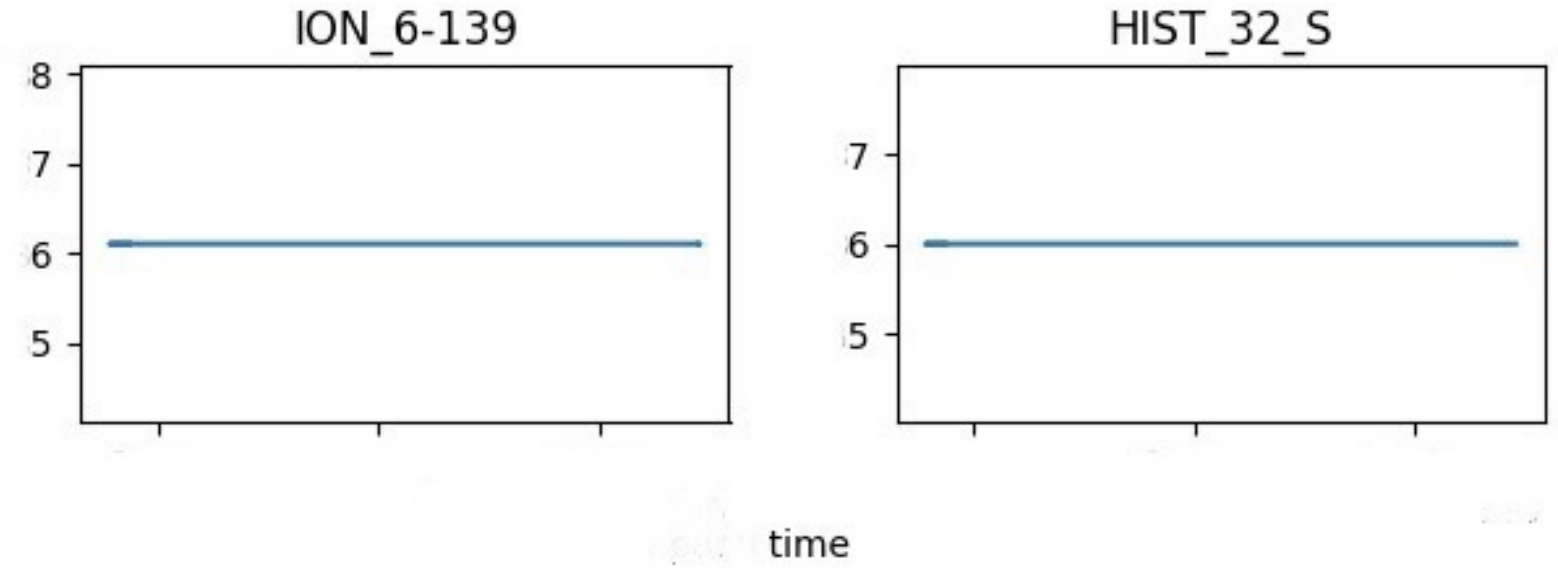
Rolling Average

Autoregression

Level Shift

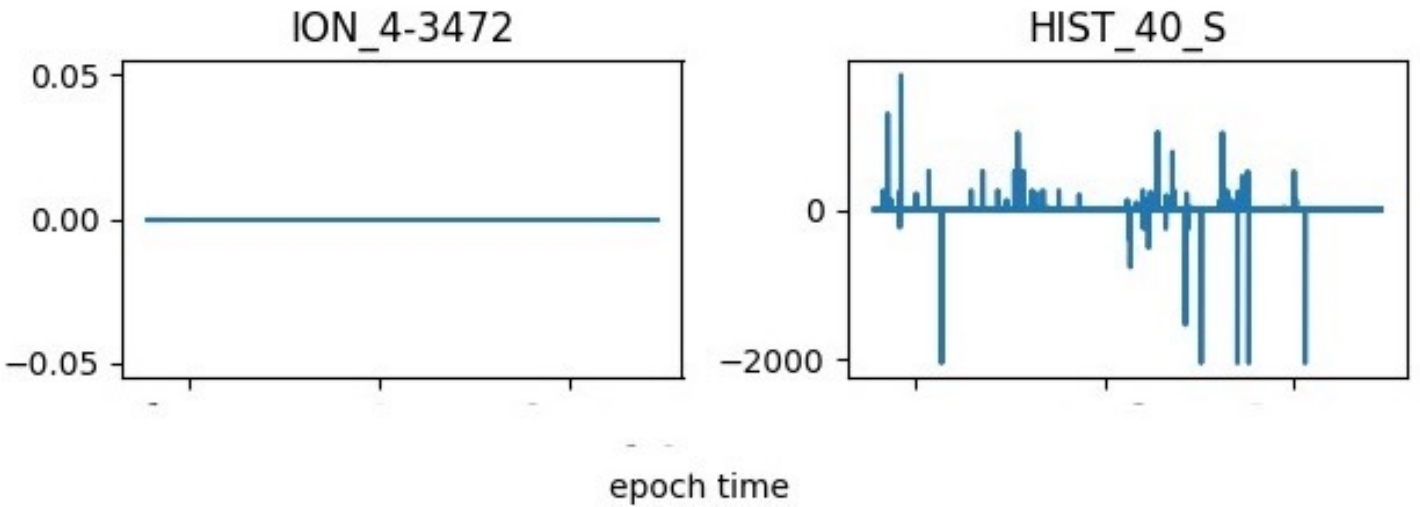
```
Steps:
100 HIST
2 ION
Runtime: 2318.579178094864
0.0  :  ['ION_4-3472', 'HIST_40_S']
0.9019789354524411  :  ['ION_5-139', 'HIST_40_S']
3.1622776601683795  :  ['ION_4-3472', 'HIST_44_S']
3.272547325860909  :  ['ION_5-139', 'HIST_44_S']
4.47213595499958  :  ['ION_6-6', 'HIST_44_S']
6.928203230275509  :  ['ION_6-4', 'HIST_44_S']
9.382502917665077  :  ['ION_6-139', 'HIST_32_S']
```

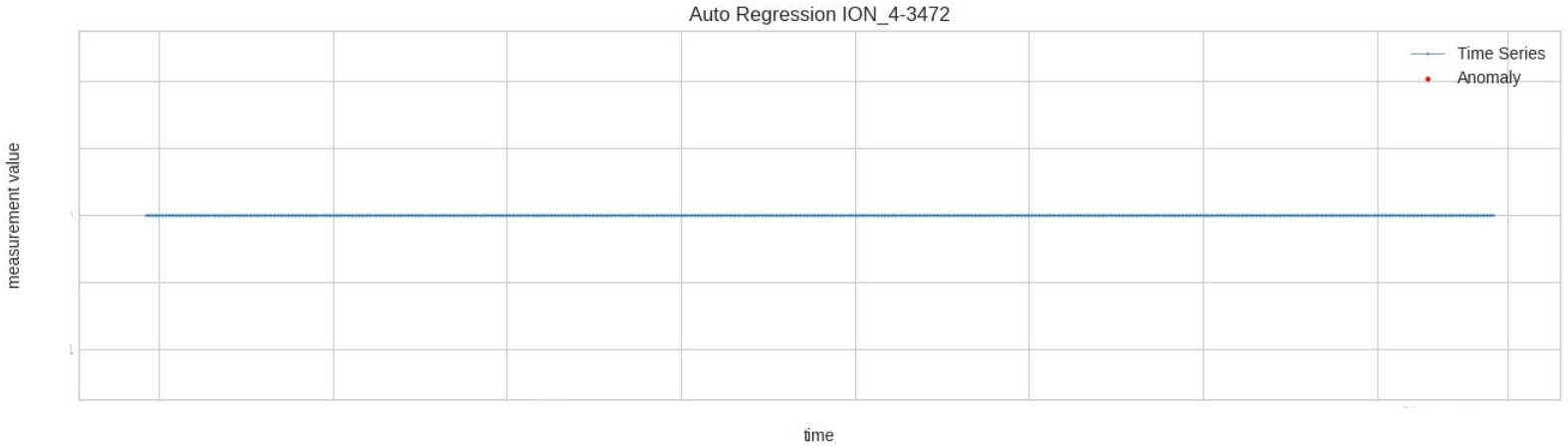
Results

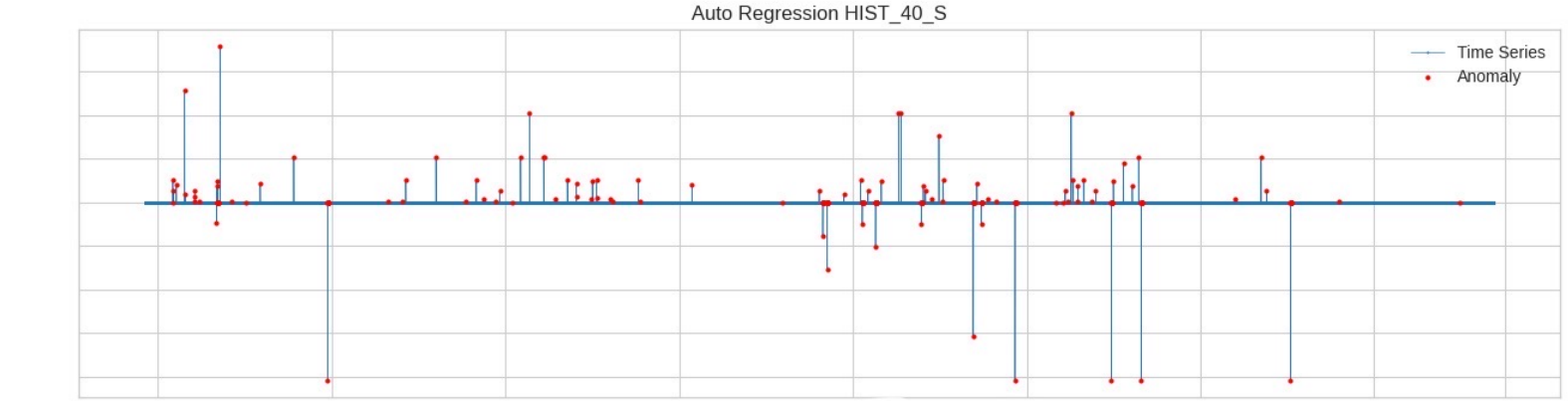


Results

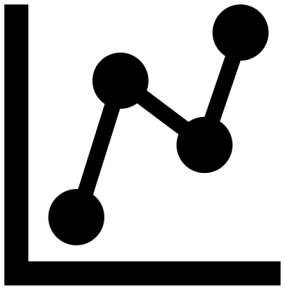
```
Steps:
100 HIST
2 ION
Runtime: 2318.579178094864
0.0  :  ['ION_4-3472', 'HIST_40_S']
0.9019789354524411  :  ['ION_5-139', 'HIST_40_S']
3.1622776601683795  :  ['ION_4-3472', 'HIST_44_S']
3.272547325860909  :  ['ION_5-139', 'HIST_44_S']
4.47213595499958  :  ['ION_6-6', 'HIST_44_S']
6.928203230275509  :  ['ION_6-4', 'HIST_44_S']
9.382502917665077  :  ['ION_6-139', 'HIST_32_S']
```




Auto Regression ION_4-3472
Time Series
Anomaly
measurement value
time


Auto Regression HIST_40_S
Time Series
Anomaly

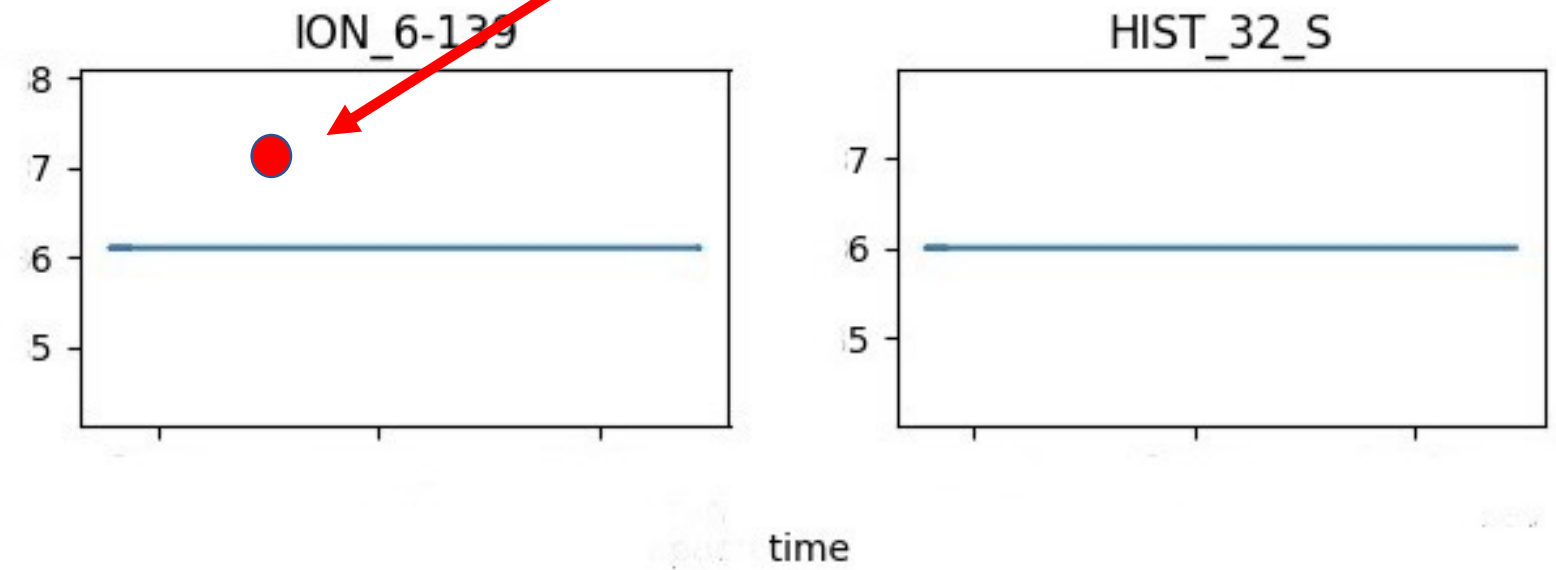
Future Work



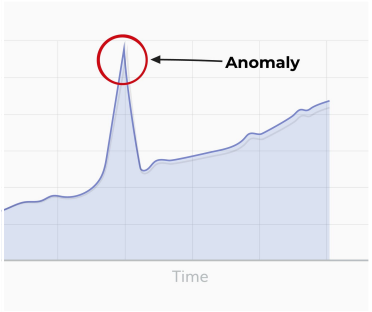
Simulate
Artificial
Anomaly

```
Steps:
100 HIST
2 ION
Runtime: 2318.579178094864
0.0  :  ['ION_4-3472', 'HIST_40_S']
0.9019789354524411  :  ['ION_5-139', 'HIST_40_S']
3.1622776601683795  :  ['ION_4-3472', 'HIST_44_S']
3.272547325860909  :  ['ION_5-139', 'HIST_44_S']
4.47213595499958  :  ['ION_6-6', 'HIST_44_S']
6.928203230275509  :  ['ION_6-4', 'HIST_44_S']
9.382502917665077  :  ['ION_6-139', 'HIST_32_S']
```

Anomaly

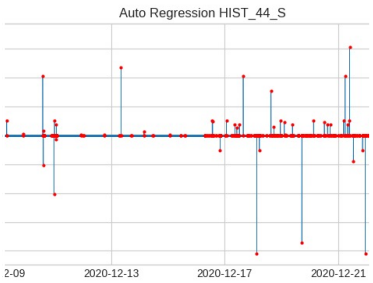


Conclusions



What is Anomaly Detection?

Background



Time Series Anomaly Detection

Applications

My research

Importance